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CONTRIBUTIONS TO THE ANALYSIS AND SYNTHESIS OF KNOWLEDGE

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INDUCTIVE LOGIC AND SCIENCE

RUDOLF CARNAP[1]

The question of the usefulness of inductive logic for science and even the question of the very possibility of inductive logic are today still debated. The conception here explained differs from that of many other scholars.

First I wish to emphasize that inductive logic does not propose *new* ways of thinking, but merely to explicate *old* ways. It tries to make explicit certain forms of reasoning which implicitly or instinctively have always been applied both in everyday life and in science. This is analogous to the situation at the beginning of deductive logic. Aristotle did not invent deductive reasoning; that had gone on as long ago as there was human language. If somebody had said to Aristotle: "What good is your new theory to us? We have done well enough without it. Why should we change our ways of thinking and accept your new invention?", he might have answered: "I do not propose new ways of thinking, I merely want to help you to do consciously and hence with greater clarity and safety from pitfalls what you have always done. I merely want to replace common sense by exact rules."

It is the same with inductive logic. Inductive reasoning is likewise as old as human language. I mean here by inductive reasoning all forms of reasoning or inference where the conclusion goes beyond the content of the premises, and therefore cannot be stated with certainty.

Thus, for example, if a physicist states a new law or a theory as a system of laws on the basis of the experimental results he has found, he makes an inductive inference. So does a scientist who assumes an unknown single fact on the basis of known facts; for example, the meteorologist who predicts the weather for tomorrow, the physicist who assumes a certain distribution of the velocities of gas molecules which he cannot directly observe, a historian who tries to explain a reported act of Abraham Lincoln by hypothetically assuming a certain

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[1] Paper read at the Symposium on Philosophy of Science, joint session of the Am. Phys. Soc. and the Philosophy of Science Association, Chicago, 27 October 1951.

motivation which is not reported, or a statistician who makes an estimate for the unknown value of a parameter in a population on the basis of an observed sample from the population. Since inductive logic merely intends to explicate common ways of inductive reasoning, the question of its usefulness leads back to the general question: Is it desirable that procedures which are generally applied, though only intuitively or instinctively, are brought into the clear daylight, analyzed and systematized in the form of exact rules? Whoever gives an affirmative answer to this general question will acknowledge the importance of the special problem of explicating inductive reasoning, that is, of constructing a system of inductive logic with rules as exact as those of the older, well-established system of deductive logic. Whether any particular system proposed as a solution for this problem is workable and fruitful is, of course, another question.

As I see it, the fundamental concept of inductive logic is *probability*. All inductive reasoning is probability reasoning. However, the word 'probability' is not unambiguous. I refer here to probability in one particular sense, the logical sense, which we might call *inductive probability*. This concept must be clearly distinguished from probability in the statistical sense. The distinction is practically important and theoretically fundamental.

Statistical probability is a certain quantitative physical characteristic of physical systems. Like any other physical magnitude it is to be established empirically, by observations. In this case the observations are of a statistical nature. They consist in counting frequencies. Statistical probability is obviously very closely connected with frequency, but it is not just the same as frequency. When we say that for a given die the probability of throwing an ace is 0.158, then this statement refers to a physical characteristic of the die and thus is not fundamentally different from statements about its mass, temperature, electric conductivity, etc. Imagine a fictitious physicist who, like the Laplacean superman, knows the present micro-state of the die in terms of the distribution of the particles and of the fields and, in addition, all the relevant laws. This physicist could, by purely mathematical calculations, find not only the present temperature of the die, its conductivity, etc., but also the probability of its yielding an ace if thrown under specified conditions. Since the micro-state is actually not known, the question arises how to test a statement about the probability, how to confirm or disconfirm it. The answer in the case of

probability is not fundamentally different from that in the case of temperature or other physical magnitudes. The statement is to be tested by making experimental arrangements which lead to observable phenomena connected with the magnitude in question, whose value itself is not directly observable. To test the probability statement, we determine the relative frequency of aces in a sufficiently long series of throws of the die. This frequency is itself not the probability; it is rather a consequence of the probability state of the die, a consequence which is observable and therefore may serve for us as a symptom for the probability state, just as the expansion of the mercury column in the thermometer is not itself the temperature but an observable consequence of the temperature state and therefore a suitable means of testing a statement about the temperature. It is sometimes said that the statistical concept of probability involves a peculiar difficulty, since obviously no finite series of throws is sufficient to determine the probability with absolute precision and certainty. This is indeed true, but the same holds for all physical magnitudes. There is likewise no possible procedure for determining the temperature with absolute precision and certainty. The answer to the question: "How long then shall we make the series of throws with the die in order to determine the probability?" is the same as the answer to the question: "How fine a thermometer should we use to measure the temperature?" In both cases the answer depends, on the one hand, on the time and money available and, on the other hand, on the desired degree of precision. More specifically, it depends on the theoretical or practical advantages to be expected from higher precision. The finer the thermometer and the longer the series of throws, the higher the precision which is achieved. In neither case is there a perfect procedure. The concept of statistical probability may be introduced either by an explicit definition in terms of a limit as done by Mises and Reichenbach, or by an axiom system with rules of application as done by the majority of contemporary statisticians. In either case, the concept is logically legitimate and practically useful for work in statistics and in all branches of science which apply statistical methods. Thus I do not agree with those representatives of the inductive concept of probability, like Keynes and Jeffreys, who reject the statistical concept. On the other hand, I do not agree with Mises, Reichenbach, and the statisticians, who reject the inductive concept. Both concepts of probability are important for scientific work,

each in its own field, the one within science itself, the other in inductive logic, which gives rules for certain operations with the statements of the language of science. The statistical concept is today generally recognized. Although certain problems connected with it are still under investigation, a defense of its legitimacy and usefulness is no longer necessary. The status of the inductive concept, however, is still debated. Therefore, today it is still necessary to defend its right of existence and to show its usefulness.

A statement of inductive probability states a relation between a hypothesis and a given body of evidence, e.g., results of actual or possible observations. The asserted probability value means the degree to which the hypothesis is confirmed or supported by the evidence. It is important to notice that a statement on inductive probability or *degree of confirmation* is relative to the evidence. This does not merely mean that the statement is based on or derived from observations. That is the case for *every* scientific statement. For example, the statement "The probability that it will rain tomorrow is 1/5" is incomplete unless we add "with respect to such and such an evidence", e.g., certain meteorological observations. For the validity of the statement it does not matter whether the evidence referred to in the statement is true and whether it is known to the speaker. To be sure, in the practical application of any inference, whether deductive or inductive, the premises are usually known. But that is not necessary. They may be unknown or they may even be known to be false. If this is so, what can be the basis of the validity of the probability statement itself, as distinguished from the validity of the hypothesis or the evidence? It can obviously not be of an empirical nature. All relevant empirical knowledge or assumption is contained in the evidence statement. In our example, we can empirically reexamine the truth of the evidence concerning past meteorological events. If we wait until tomorrow, we can empirically test the truth of the hypothesis that it will rain tomorrow. But in neither way can we test the truth of the probability statement itself. We shall see tomorrow either rain or not-rain, we may observe a rain of short or of long duration, a rain of high or low intensity, but we shall not see a rain of probability 1/5. Some critics of inductive logic have pointed to this fact and drawn from it the conclusion that, since the inductive probability statement is not empirically testable, it must be scientifically meaningless. Their mistake was that they regarded the probability statement as a factual synthetic

statement. The statement is, however, of a purely logical nature. Hence there is no need and no possibility of empirical testing. A statement of inductive probability is in one respect similar to a statement in deductive logic: the relation between the hypothesis and the evidence which it asserts is a logical relation, similar to the deductive relations of deducibility or incompatibility, though weaker than those. If the statement asserts a probability value close to 1, then the probability relation hereby expressed is very close to the relation of deducibility: the hypothesis is nearly deducible from the evidence but not quite. On the other hand, if the stated probability value is near to 0, then the probability relation is close to the deductive relation of incompatibility: the hypothesis is nearly incompatible with the evidence but not quite. For any intermediate probability value the probability relation is more remote from the deductive relations which are, so to speak, the extreme cases. Thus inductive probability means in a sense partial deducibility. It is a logical relation inasmuch as it can be established, just as a deductive relation, as soon as the two statements of hypothesis and evidence are given, by merely applying logical analysis, in this case the rules of inductive logic, without the use of observations. Although the statement expresses only a logical relation, it has nevertheless significance. It draws boundaries to reasonable conduct. For example, if the probability of rain tomorrow is 1/5 with respect to the evidence available to an observer, then it would not be reasonable for him to bet on rain tomorrow at odds higher than 1:4.

If we recognize that statements on inductive probability have a purely logical character, then we are in a position to clear up a question which has been debated for two hundred years: the problem of the so-called principle of insufficient reason or *principle of indifference*. As I see it, the beginning of the development of inductive logic was made in the classical theory of probability by men like Bernoulli, Bayes, and Laplace. Many points of the classical theory, and among them also fundamental points, have been criticized for more than a hundred years and especially in our century. I think that this criticism is correct to a large extent. I agree with the critics that today it is impossible to go back to the classical conception. But I do not agree with those who say that the only way out is the total rejection of the classical conception. The classical principle of indifference states: "If no reasons are known which would favor one of several possible events, then the events are to be

taken as equally probable." The usual objection against this principle is that it puts a premium on ignorance; if you do not know anything about the alternatives, then the principle allows you to make a certain statement about them; if you know certain things, then that statement is no longer permissible. To derive a statement from ignorance looks rather absurd. And it would indeed be absurd to apply this procedure to a factual statement. But the statement of equiprobability to which the principle of indifference leads is, like all statements on inductive probability, not a factual but a logical statement. If the knowledge of the observer does not favor any of the possible events, then with respect to this knowledge as evidence they *are* equally probable. The statement assigning equal probabilities in this case does not assert anything about the facts, but merely something about the logical relations between the given evidence and each of the hypotheses; namely, that these relations are logically alike. These relations are obviously alike if the evidence has a symmetrical structure with respect to the possible events. The statement of equiprobability asserts nothing more than the symmetry.

For these reasons I believe that the basic idea of the old principle of indifference is valid. On the other hand, there can be no doubt that many of the applications of this principle, especially in the earlier period, were invalid and that some of the conclusions drawn were even outright absurd. But I believe that the aim which the classical pioneers envisaged was valid. Our task is not to abandon entirely the classical conception, but to construct an exact concept of degree of confirmation explicating the classical conception of inductive probability on a more cautious and more solid foundation.

Now let us look at the function of inductive logic in the field of science. A scientist makes, on the one hand, observations of natural phenomena or of results of experiments. These constitute his evidence. On the other hand, he entertains hypotheses concerning facts not yet observed or even unobservable. The hypothesis may concern a single fact or it may be a conditional prediction of the form "If we were to do such and such things, then such and such events would happen", or it may have a general form, e.g., a statement about the value of a material constant, or a general law stating the relations between various physical magnitudes in terms of mathematical functions. The law may have a deterministic form or a statistical form, stating e.g., proportions, averages, or other statistical

parameters of distributions of certain magnitudes. The purpose of the law is to explain known phenomena and predict new ones. The task of inductive logic is not to *find* a law for the explanation of given phenomena. This task cannot be solved by any mechanical procedure or by fixed rules; it is rather solved through the intuition, the inspiration, and the good luck of the scientist. The function of inductive logic begins *after* a hypothesis is offered for examination. Its task is to measure the support which the given evidence supplies for the tentatively assumed hypothesis. In particular, the task will often be to determine among several competing hypotheses the one which is most strongly confirmed by the given evidence. The competing hypotheses may, for example, concern the possible results of an experiment to be made, the possible causes of an observed event, or possible outcomes of a business investment. Or they may be various laws which are mutually incompatible, each of which might be regarded as an explanation of a given set of observational results concerning new phenomena not explained so far.

Sometimes an objection is raised against the idea of a system of inductive logic with exact rules for the determination of the degree of confirmation because of the fact that a scientist who chooses one among a number of considered hypotheses is influenced in this choice also by many non-rational factors and that he would not be willing to hand over the task of this choice to a machine or to have himself, so-to-speak, transformed into a machine which merely applies fixed rules. Now it is true that many non-rational factors affect the scientist's choice, and I believe that this will always be the case. The influence of some of these factors may be undesirable, for instance a bias in favor of a hypothesis previously maintained publicly or, in the case of a hypothesis in social science, a bias caused by moral or political preferences. But there are also non-rational factors whose effect is important and fruitful; for example, the influence of the "scientific instinct or hunch". Inductive logic does not intend to eliminate factors of *this* kind. Its function is merely to give to the scientist a clearer picture of the situation by demonstrating to what degree the various hypotheses considered are confirmed by the evidence. This logical picture supplied by inductive logic will (or should) influence the scientist, but it does not uniquely determine his decision of the choice of a hypothesis. He will be helped in this decision in the same way a tourist is helped by a good map. If he uses

inductive logic, the decision still remains his; it will, however, be an enlightened decision rather than a more or less blind one.

In addition to judging the status of hypotheses, inductive logic has also the task of supplying rules of *estimation*. There is much discussion and controversy among statisticians concerning the validity of particular methods of estimation and the choice of a suitable method of estimation in a given problem situation. I believe that, if the basis of inductive logic is constructed by laying down rules for calculating the degree of confirmation, then it is possible to define a general estimate function in terms of degree of confirmation, applicable to all kinds of magnitudes expressible in the language in question. The definition which I propose takes as the estimate of the magnitude on the basis of a given body of evidence the weighted mean of the possible values of the magnitude, the weight of each value being its degree of confirmation with respect to the given evidence. This is the same as the expectation value of the magnitude (if we understand the term 'expectation value' in the inductive sense based on inductive probability, in contrast to its statistical sense based on statistical probability). To obtain a general method of estimation would be of great importance not only from a *theoretical* point of view but also for the problem of determining *practical* decisions in a rational way. Suppose a man has to make a decision in a given economic situation, e.g., concerning investments. This means that he has to choose one among a number of alternative actions possible to him in the situation. For each possible action he considers the various possible outcomes in terms of money gained. If he is able to determine the degree of confirmation for each possible outcome in the case of the considered action, he may calculate the sum of these gains, each multiplied with its degree of confirmation. This will be his estimate of the gain in the case of the action considered. In the same way, he may calculate the estimate of the gain for each of the possible actions. Then, if he is a rational man, he will choose that one among the possible actions for which the estimated gain has its greatest value. (A more exact procedure would consider, not the gain in terms of money, but the utility of this gain, i.e., the measure of satisfaction derived by the person from the gain.) Thus inductive logic serves as an instrument for the determination of rational decisions.

As mentioned earlier, the development of inductive logic began with the classical theory of probability. However, its systema-

tization as a branch of modern logic is of recent origin, beginning with John Maynard Keynes thirty years ago. I have constructed a set of rules of inductive logic for a simple language system, which is restricted to qualitative descriptions of things without the use of measurable magnitudes (like temperature, electric current, etc.), but including statements of frequencies. These rules make possible the calculation of the degree of confirmation for any hypothesis and any body of evidence expressible in that language system and the calculation of the estimate of a frequency on the basis of any given evidence. The further development of inductive logic for more comprehensive language systems and finally for the language of science as a whole remains a task for the future.

A theory of inductive logic is systematically developed in my book *Logical Foundations of Probability*, Chicago, 1950. The underlying conception of inductive probability is explained in *The Nature and Application of Inductive Logic*, Chicago, 1951, which is a reprint of six non-technical sections from the book mentioned.

ON MENTAL ENTITIES

W. V. QUINE*

Harvard University

A question which is very much in the air this evening — very close to the discussion even when not directly discussed — is whether we should affirm or deny that there are such things as *sensations,* these being conceived as immediate, subjective experiences. I shall touch on this question, but not just yet. For a while it will be convenient to talk as if there are.

Falling in thus uncritically with the usage of old-fashioned epistemology and introspective psychology, let us consider, to begin with, the process of language. It has been the fashion in recent philosophy, both that of some of the English analysts and that of some of the logical positivists, to think of the terms of science and ordinary language as having some sort of hidden or implicit definitions which carry each such term back finally to terms relating to immediate experience. Now this view is clearly unrealistic. A better description, though countenancing the notion of immediate experience still, is as follows. On the one hand we have language, as an infinite totality of said or appropriately sayable phrases and sentences. On the other hand we have our sense experience, which, by a process of psychological association or conditioned response, is keyed in with the linguistic material at numerous and varied places. The linguistic material is an interlocked system which is tied here and there to experience; it is not a society of separately established terms and statements, each with its separate empirical definition. There is no separate meaning, in terms of direct experience, for the statement that there is a table here, or that there is a planet somewhere in outer space. The statement that there is the planet may be keyed with our sense experience by our seeing the planet, or by our merely noting perturbations in the orbits of other planets. And even the statement that

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there is a table right here may be keyed with our sense experience through touch *or* sight *or* hearsay. Again the statement that I have cut my finger may be tied with experience either by sight or by pain or both. I have often argued that it is mistaken even to try to distinguish between those scientific statements which are true by virtue of the meanings of our terms and those which are true or probable by inductive evidence. As Pierre Duhem urged, it is the system as a whole that is keyed to experience. It is taught by exploitation of its heterogeneous and sporadic links with experience, and it stands or falls, is retained or modified, according as it continues to serve us well or ill in the face of continuing experience.

We get the system, in its main lines, from our forebears. As children learning the language, we get on to various simple terms and key phrases by direct association with appropriate experiences. When we have progressed a bit with this kind of learning, we learn further usages contextually. Eventually we are in a position to receive traditional doctrine a whole chapter at a time. Finally some men venture to revise the tradition here and there, for the sake of greater simplicity or better experiential links; and these are scientists.

So much for the individual's mastery of language and lore; but what of the origins of all this in the race? It would be irrational to suppose that those origins were rational. The prehistory of science was probably a composite of primitive unconscious symbolism of the Freudian kind, confusions of sign and object, word magic, wishful thinking, and a lazy acquiescence in forms whose motivation had been long forgotten. Biases in our conceptual schemes may have great utility in the systematizing of science, and therewith high survival value, despite humble origins in the random workings of unreason — just as chance mutations in the chromosome may launch a sturdy and efficient new race. Natural selection through the ages tends to favor the happy accidents at the expense of the unpropitious ones, in the evolution of ideas as in the evolution of living species.

As scientists we accept provisionally our heritage from the dim past, with intermediate revisions by our more recent forebears; and then we continue to warp and revise. As Neurath has said, we are in the position of a mariner who must rebuild his ship plank by plank while continuing to stay afloat on the open sea.

How do we decide on such retentions and revisions? To be more specific: how do we decide, apropos of the real world,

what things there *are?* Ultimately, I think, by considerations of simplicity plus a pragmatic guess as to how the overall system will continue to work in connection with experience. We posit molecules, and eventually electrons, even though these are not given to direct experience, merely because they contribute to an overall system which is simpler as a whole than its known alternatives; the empirical relevance of the notion of molecules and electrons is indirect, and exists only by virtue of the links with experience which exist at *other* points of the system. Actually I expect that tables and sheep are, in the last analysis, on much the same footing as molecules and electrons. Even these have a continuing right to a place in our conceptual scheme only by virtue of their indirect contribution to the overall simplicity of our linguistic or conceptual organization of experience; for note that even tables and sheep are not direct sensations.

The notion of macroscopic objects, tables and sheep, differs from that of molecules and electrons mainly, from an epistemological point of view, in point of degree of antiquity. Molecules were posited consciously in historic times, whereas the positing of the external objects of common sense is an original trait of human nature. Men have believed in something very like our common-sense world of external objects as long, surely, as anything properly describable as language has existed; for the teaching of language and the use of it for communication depend on investing linguistic forms with intersubjectively fixed references. It would be senseless to speak of a motive for this archaic and unconscious posit, but we can significantly speak of its function and its survival value; and in these respects the hypothesis of common-sense external objects is quite like that of molecules and electrons.

Because the notion of external macroscopic objects is so fundamental both to the origins of language and to the continued learning of language, we may be pretty sure that it is here to stay, though electrons and other more hypothetical entities may, with the continued revisions of science, come and go. Experience is continually reminding us that it is over the external macroscopic objects that there is least semantical misunderstanding between speakers; it is naturally to tables and sheep and the like that we keep returning when there is trouble about new concepts.

Epistemologists, put off by the fact that macroscopic objects are epistemologically on the same footing as molecules and

electrons, have looked to sense data — the raw content of sensation itself — as a more ultimate realm of entities. The ensuing difficulties are notorious. They may be seen most vividly if to begin with we think about memory. Our present data of our own past experiences are, on this theory, some sort of faint present replicas of past sense impressions; faint echoes of past sensation accompanying the blare of present sensation. Now it takes little soul-searching to persuade oneself that such double impressions, dim against bright, are rather the exception than the rule. Ordinarily we do not remember the trapezoidal sensory surface of a desk, as a color patch extending across the lower half of the visual field; what we remember is *that* there was a desk meeting such-and-such approximate specifications of form and size in three-dimensional space. Memory is just as much a product of the past positing of extra-sensory objects as it is a datum for the positing of past sense data.

What has been said just now of memory applies in some degree to the stream of sensory experience generally. It would be increasingly apparent from the findings of the Gestalt psychologists, if it were not quite apparent from everyday experience, that our selective awareness of present sensory surfaces is a function of present purposes and past conceptualizations. The contribution of reason cannot be viewed as limited merely to conceptualizing a presented pageant of experience and positing objects behind it; for this activity reacts, by selection and emphasis, on the qualitative make-up of the pageant itself in its succeeding portions. It is not an instructive over-simplification, but a basic falsification, to represent cognition as a discernment of regularities in an unadulterated stream of experience. Better to conceive of the stream itself as polluted, at each succeeding point of its course, by every prior cognition.

So the notion of pure sense datum is a pretty tenuous abstraction, a good deal more conjectural than the notion of an external object, a table or a sheep. It is significant that when we try to talk of the subjective we borrow our terminology from the objective: I feel as if I were falling, I have a sinking sensation, I feel on top of the world, I see pink elephants (better: I feel as if I were really seeing real pink elephants), etc. Even the terms which we have come to regard as strictly and immediately sensory, like 'red', are obviously objective in reference in the first instance: we learn the word 'red' by being confronted with an external object which our parent calls red, just as we learn the word 'sheep' by being confronted with

an external object which our parent calls a sheep. When, at a certain stage of epistemological sophistication, we transfer the word 'red' to an alleged datum of immediate subjective sense experience, we are doing just what we do when we say we have a sinking sensation: I feel *as if* I were really, externally falling, and I feel *as if* I were really confronted by an external red object.

I suggest that it is a mistake to seek an immediately evident reality, somehow more immediately evident than the realm of external objects. Unbemused by philosophy, we would all go along with Dr. Johnson, whose toe was his touchstone of reality. Sheep are real, unicorns not. Clouds are real, the sky (as a solid canopy) not. Odd numbers are perhaps real, but prime even numbers other than 2 not. Everything, of course, is real; but there are sheep and there are no unicorns, there are clouds and there is (in the specified sense of the term) no sky, there are odd numbers and there are no even primes other than 2. Such is the ordinary usage of the word 'real', a separation of the sheep from the unicorns. Failing some aberrant definition which is certainly not before us, this is the only usage we have to go on.

The crucial insight of empiricism is that any evidence for science has its end points in the senses. This insight remains valid, but it is an insight which comes after physics, physiology, and psychology, not before. Epistemologists have wanted to posit a realm of sense data, situated somehow just me-ward of the physical stimulus, for fear of circularity: to view the physical stimulation rather than the sense datum as the end point of scientific evidence would be to make physical science rest for its evidence on physical science. But if with Neurath we accept this circularity, simply recognizing that the science of science is a science, then we dispose of the epistemological motive for assuming a realm of sense data. May we then make a clean sweep of mental entities?

I urged earlier that we decide what things there are, or what things to treat as there being, by considerations of simplicity of the overall system and its utility in connection with experience, so to speak. I say "so to speak" because I do not want to force the issue of recognizing experience as an entity or composite of entities. I have talked up to now as if there were such entities; I had to talk some language, and I uncritically talked this one. But the history of the mind-body problem bears witness to the awkwardness of the practice. We are virtually bound, as remarked earlier, to hold to an ontology of external

objects; but it is moot indeed whether the positing of additional objects of a mental kind are a help or a hindrance to science. Or perhaps not so moot. At any rate it is moot or else it is clear that they are a hindrance.

To repudiate mental entities is not to deny that we sense or even that we are conscious; it is merely to report and try to describe these facts without assuming entities of a mental kind. What is spoken of in terms of the residual posited objects of science and common sense as my cut finger is keyed into our nervous responses in various ways; nerves from my eye and other eyes are involved, and nerves from my finger. Some persons are so situated as to be accessible to the stimuli which are most closely relevant to the phrase 'Quine's cut finger' and some are not. A dozen of us are in a position, this evening, for the appropriate stimulation of the eye, and one of us for the appropriate stimulation of the finger.

None of us is oriented to external objects quite like anyone else, for we occupy different positions, and while we exchange positions the objects age. None of us learned his words quite like anyone else. But we use them in sufficient systematic agreement for fair communication — which is no accident, since language is subject to the law of survival of the fittest. We manage to talk effectively about other people's cut fingers because of a pattern of habits connecting with present and past stimulation of the eye together with past stimulation, under optically similar circumstances, of our own fingers. The same is true of pain — but no argument against construing pain as a state of the physical organism. If we repudiate mental entities as entities, there ceases to be an iron curtain between the private and the public; there remains only a smoke screen, a matter of varying degrees of privacy of events in the physical world. Consciousness still retains a place, as a state of a physical object, if — following the suggestion made by Professor Deutsch in addressing this institute last year — we construe consciousness as a faculty of responding to one's own responses. The responses here are, or can be construed as, physical behavior. It is not the purpose of this view to leave any aspect of life out of account. The issue is merely whether, in an ideal last accounting of everything or a present practical accounting of everything we can, it is efficacious so to frame our conceptual scheme as to mark out a range of entities or units of a so-called mental kind in addition to the physical ones. My hypothesis, put forward in the spirit of a hypothesis of natural science, is that it is not efficacious.

A BIBLIOGRAPHY OF CYBERNETICS

F. Dermot Barrett and Herbert A. Shepard
Massachusetts Institute of Technology

INTRODUCTION

Norbert Wiener defines cybernetics as "the study of messages, and in particular of the effective messages of control," and as "the entire field of control and communication theory, whether in the machine or in the animal." His book, *Cybernetics*, is the central work to which other items in this bibliography are related.

Cybernetics owes many of its elements to the practical science of communication engineering. In recent years the demand for complex communication devices such as television, automatic control systems, and large-scale computing machines made the need for an adequate theory of communication evident. Wiener, Shannon, and many others have contributed to a general theory of communication and control which Wiener calls cybernetics. For communications engineers, therefore, there is nothing revolutionary in cybernetics as it applies to their own work. For biological and social scientists, however, cybernetics presents a new point of view and system of concepts for studying the organism and its relations with other organisms and with the inorganic environment.

The prime concept in cybernetics is information. The term information refers to the representation of an event. If information is transmitted without loss from a transmitter to a receiver, then the pattern which existed among the elements at the transmitter will be represented in the arrangement of other elements at the receiver. Patterns, not elements, are transmitted. Most physical sciences are primarily concerned with the transmission of matter and energy. Cybernetics is interested in matter and energy only insofar as they are bearers of information.

The central interest of cybernetics is in the way information is used for controlling processes. A control mechanism is a system which uses information from other systems for continuously determining its own action relative to them. Control systems include all those which can be called adjustive or adaptive: servomechanisms, organisms, and social organizations. Thus

cybernetics provides conceptual apparatus applicable to an enormous range of phenomena.

In addition, cybernetics provides a new frame of reference for considering some long-standing philosophical problems. The construction of machines which reproduce a set of functions hitherto restricted to organisms has called for a re-examination of such matters as free will, teleology, consciousness and scientific method. Some of the most noteworthy explorations of the meta-scientific aspects and philosophical implications of cybernetics have been those undertaken by Karl W. Deutsch and by D. M. MacKay.

The bibliography has been selected with the interests of social scientists in mind and engineering applications have been omitted, except for general material on servomechanisms and communication systems. For convenience, the bibliography has been classified under six headings, although some works properly belong in more than one category. The first class, "Popular Expositions," is intended for the casual or lay reader who seeks a non-technical treatment. The core literature is included under the heading "Cybernetics." The third and fourth categories, "Information Theory and Communication Theory" and "Servomechanisms," represent two major foundations or branches of the science. The fifth class, "Cybernetics Concepts in the Biological and Social Sciences," consists of the literature concerned with applying the viewpoint of cybernetics to the life sciences. The rate of output of such literature is increasing rapidly, but the total quantity is still small enough that most of it could be included. It is likely, however, that within a short time some of the material included here will be seen as inferior in quality and of secondary importance. The sixth class, "Relevant Works in Social Science, Biology, and Philosophy," represents a somewhat arbitrary selection. The very relevance of cybernetics to many scientific fields has made this necessary. Thus Cannon's *The Wisdom of the Body*, written nearly thirty years ago, is undoubtedly a "relevant" work since its viewpoint is in such close harmony with that of cybernetics, whereas Barnard's *Functions of the Executive* is a much less clear-cut case, and has been included for the sake of scattered insights rather than for its general approach.

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SIGNIFICS
ITS TENDENCY, METHODOLOGY, AND APPLICATIONS

D. VUYSJE

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Preface

This monograph aims to give a survey of the development of signific studies during these last thirty-five years and to show the place the signific movement occupies among movements having similar tendencies, like Logical Empiricism, Operationism, Pragmatism and Semantics.

To *Professor Philipp Frank*, who has been an active member of the *International Society for Significs* for some years, I owe the suggestion to write a monograph in which the signific principles should be described and which should stress the similarity and the difference between significs and other theories of signs. I had the good fortune to discuss with him personally some of the fundamental problems occurring in this treatise, and to him go my warm thanks for his encouragement and help.

It may be obvious that the conceptions gathered in a monograph of this kind represent a selection of the contributions of many writers and that, also with a view to its conciseness, it is not possible to trace individual discoveries back to their authors. Moreover, in many cases it is extremely difficult to trace the personal influences which have given rise to certain views. Considering this, I have followed the procedure to add the names of the writers only to those statements which, according to my subjective judgment, are characteristic of the personal conceptions of the authors and have fruitfully influenced

research in a signific direction. I may be excused if I do not name the many other scientists who have given valuable contributions to signific investigations.

One exception should be made in this respect with regard to my old friend *Professor G. Mannoury*. The discussions on significs I have had with him regularly for nearly twenty years, on problems referring to the relation between linguistic phenomena and human behavior, have more than anything else influenced my conceptions, which have partly found expression in this monograph, in which I have tried to shape significs in its essential lines. I am particularly indebted to him for his fine and stimulating spirit of cooperation which I have had the privilege of enjoying during these years and, in this special case, I am much obliged to him for the suggestions he made after reading the manuscript.

My thanks also go to my friend *Dr. H. J. Groenewold*, who has also been willing to read the manuscript and whose critical remarks have been of great advantage to me.

And, finally, I wish to express my deep gratitude to my friends and co-members of the *International Society for Significs;* without my personal participation in the activities of this circle I would not have been able to write this monograph, which, I hope, may be a modest contribution to the theory of signs and its applications.

D. VUYSJE

Amsterdam, June 1952

I. Tendency

One could say that from the outset signific studies have had a threefold aspect: a linguistic one, a psychological one and an epistemological one. On the one hand, the construction of efficient terminologies has been up to the present time one of the items of signific programs; on the other hand, the signific approach has implied a psychological investigation of the existing means of understanding, a psychological analysis of the linguistic behavior of individuals and groups. And more often than not this signific activity has been associated with an inquiry into the foundations of epistemological problems.

The program drawn up in 1919 by the *International Institute for Philosophy* at Amsterdam — one of the precursors of the *International Society for Significs* — already gave expression

to this triple aspect and, although it was not carried out at that time, it nevertheless contained valuable directives for later signific groups. Taking as a starting-point the almost universally admitted opinion that language is not able to represent or to render any part of "reality" adequately, but that the "meaning" of words is merely dependent on the effect the speaker aims at or the hearer undergoes, the authors wished to point out that this changeability and relativity of significance, inherent in language, can reveal themselves in a different degree and in different forms. In general, it may be said that, according as the needs of man require more differentiated actions, language, too, should be more differentiated and more stabilized to that purpose. This stability was furthered externally by writing and printing, internally by what might be called the organization of language, i.e., by establishing the connection of the significance of a word with that of other words. This becomes evident in *definitions*, such as occur in the most exact form in mathematics and juridical science, but which are present in any discipline. To these phenomena of organization also belong all connections of words, such as have been passed on by custom and usage, without being fixed explicitly by the authority of government and science. These connections of words already play an important part in the early linguistic behavior of the child, and to them we may attribute the slight occurrence of "basic words" in children's talk, i.e., of words the child is not acquainted with by means of other words, but only by indication and imitation. Soon, the syntactic connections used by the adults (causal, oppositional, temporal, and others) largely influence the word-images of the child, and this influence tends to increase the stability of its small stock of words. After a few years a conversational language of a seemingly stable form has developed to such an extent that the phenomena which have been described as "changeability" and "relativity" of significance, so to say, may be rediscovered by reflection and observation of language. In the history of language (in the field of linguistics, too, phylogenesis and ontogenesis go hand in hand) a constant, but not regular, increase of the stability of words can be observed: a development from the poetical languages of the remote ages to the more positive mode of expression of the Greeks and Romans, the artful copiousness of the mediaeval philosophers, and, finally, the complex systems of language of modern natural and juridical science.

A new vocabulary was devised, based on a distinction between different levels of language, on the understanding that, with the exception of the words occurring in the explanatory and describing text, the words of each level imply only acquaintance with those of the preceding levels. The consideration underlying this division was that either the syntactic connections on some levels are not or are hardly discernible (primitive language and children's talk), or that they are easily discernible (expressive language), or that they have become the essential element of communication (colloquial language), and that on other, "higher" levels, especially the scientific and the symbolic ones, these connections are founded, at least for the greater part, on conventions or on postulated formulas regarding the symbols used.

It was expected that by this procedure the relativity of the significance of words would make itself apparent, and that those "human needs" of which the wording till then had been excluded from the scope of the prevailing word connections would come to be carefully considered; furthermore, that the discrimination between the emotive and the indicative value of words would prove to be a great help for unravelling inveterate misunderstandings existing in almost every domain of human mental activity.

These tendencies revealed themselves also in the "declaration of principles" of the Significs Circle (1922-1924)[1] which, besides, emphasized the empirical aspect of the significs approach.

"The significance of an act of communication for speaker and hearer cannot but partly be judged from the words and symbols used and can only approximately be expressed in other words. However, there is a great difference in the measure in which this analysis of words and this approximation are possible. In the language of science (especially in mathematical language) and, in a small measure, in that of technology, a rather great stability in the signification of words and linguistic acts can be attained by indication and gradual defining, while primitive, passionate and poetical language, and even colloquial language, is not appropriate to the introduction of definitions (in the proper sense of the word). On passionate and poetical levels of language there are very complicated complexes of conscious and half-conscious elements of thought and feeling, inherent in the word-images, although — it goes without saying — neither the intellectual aspects nor the emotive and volitive ones are entirely absent in any linguistic act.

"From this distinction result various shades of linguistic trends, of which the logico-formalistic and the immediate-intuitive ones may be considered as extreme forms and which constitute, together and in mutual connection, the contents of a signific linguistic investigation.

"This investigation should be carried on more systematically than before and include, besides an introspective investigation into the subconscious elements, the application of experimental and statistic methods."

A circular published in 1923 by the same circle and requesting cooperation for a revision of the nomenclature, especially in the peripheral domains, of the following branches of science: *Linguistics, psychology, theology, logic, sociology, jurisprudence, ethnology, mathematics, physics, chemistry* and *biology,* proved to be attractive to a number of scientists in the Netherlands and in other countries who were dissatisfied with the use of slogans and non-analyzed terms even in the field of the "exact sciences."

The fundamental principles outlined above also found expression in the program of the group of scientists who united round the journal *Synthèse* in 1937 and who laid the foundations for the activities of the *International Society for Significs,* whose main objective has been described as: "The practising, on an international scale, of analytic and synthetic signifies in general, and its application to the theories of the foundations of the sociological, cultural, political and exact sciences in particular."

The distinction referred to in this item provides for research from an analytic and a synthetic point of view. The analytic approach deals with a signific investigation of a given language, and more particularly with an inquiry into the psychological background of the existing means of understanding. The occurrence, on the one hand, of words which are not at all associated with other words ("basic words", e.g., exclamations) and, on the other hand, of words which take their content from a description by means of other words (symbolic language) may be an indication for tracing out the extreme levels of an analytic gradation. The synthetic construction has as its starting-point simple elements belonging to a higher level of the analytic gradation, but which, from a synthetic point of view, are looked

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[1] For chronological particulars see also Chapter V of the present monograph.

upon as basic words, the original description of which is left out of consideration. The synthetic gradation is therefore artificially formed with a special aim and by utilizing special (physical, psychological, biological or other) material.[2]

The present program of the *International Society for Significs* pursues theoretical as well as more practical aims; it continues the research into the theories of the foundations of science and aims at the construction of an efficient scientific terminology; furthermore it promotes the empirical study of group languages (content analysis, slogan analysis, bias analysis, etc.).

Just as Logical Empiricism, Significs forms part of a more general critical tendency which during the last fifty years has revealed itself in nearly every domain of culture and of science, and which may be regarded as a reaction against the overestimation of emotional arguments, slogans and metaphors at the expense of critical analysis and observation. The creation of a non-emotional, formalistic terminology with the purpose of facilitating the reproduction of the results of observation, may be seen as one of the means to realize these aims.

However, one should not forget that this remedy does not prove to be useful with regard to the results of observation of social volitional processes which require an analysis of the human means of understanding, taking into account not only the indicative, but also the emotive and volitive elements of the processes in question.

II. Methodology

Significs aims at an investigation of the acts of communication, i.e., of acts by which living beings try to influence the behavior and the activities of other living beings. In a somewhat narrower acceptation it may be described as the scientific study of the mental associations underlying the human acts of communication, excluding the more specific departments of the science of language in the proper sense, like philology, etymology, semantics. For, viewed from a signific angle, the lexical word is not an act of communication, but the outward form common to several of these acts. And where semantics does not leave out the associations of the words with the representations, emotions and impulsions of the "speaker" and the "hearer" (i.e., the individual or group performing the

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[2] See also Chapter II.

act of communication or influenced by it), it considers them from a general point of view and neglects the individual circumstances. Therefore, the psychological analysis of the lie belongs to the domain of significs, and not to that of semantics. And even though we might argue that *every* act of communication is intrinsically purely subjective, since it is meant to influence other living beings, yet there is a great difference in the amount of satisfaction the acts of communication provoke in the speaker, a phenomenon which may give rise to a twofold distinction of the acts of communication. On the one hand, there is a category, that of the volitive expressions proper, in which this satisfaction is dependent on the choice of the hearer, whereas the other category, that of the descriptive or indicative acts of communication, brings about satisfaction mostly independent of the choice of the hearer. In the latter case, the satisfaction is connected with the degree of perfection of the act of communication itself; the volitive element is strongly repressed and the act is almost exclusively associated with our representations (e.g., the bald description of an object or an event). In this sense, the indicative value of an act of communication can be defined as the associations (in the mind of the speaker and the hearer) of recollections resulting from the observation of objects or events of the physical world — which may be reduced to the perception of resemblance and difference — whereas the emotive value has relation to the other associations, particularly to those referring to emotions and impulsions.

From these conceptions results a quite particular acceptance of "signification". In a wider sense, the (signific) meaning (signification) of an act of communication can be described as the influence the speaker aims at exercising or the hearer undergoes (active and passive signification), and also the influences which have given rise to the performing of the act of communication (symptomatic signification). In a narrower sense (signification of a word), it bears on the part a certain word or expression takes in the signification of the acts of communication in which the word or the expression has been used.

This definition clearly demonstrates the difference between the empiric method applied in significs and the introspective one used in traditional philosophic literature. A number of philosophic books are devoted to the study of the "meaning" of terms like "causality," "existence," "truth," "life," etc.; however, most of these books contain nothing else but com-

munications about the verbal associations provoked by these terms in the mind of the authors.

The signification of a word is never fully understood, not simply because it is nothing but the influence expected by the speaker with regard to the actions of the hearer, but also because every individual belongs to different groups and every group has its own "parallelism of will," which is kept up by a more or less specific language (idiom). Instead of attaching a fixed signification to a word, the significist pays more attention to the associations which are roused by the performance of an act of communication. By his analytic approach he tries to find out the mental associations connected to a word-image or a group of word-images (the "psychic correlate"), i.e., the representations or the recollections originating from the hearing, the reading, the pronouncing or the writing of a word (auditive, visual and motorial word-image).

For the main task of analytic significs may be described as the psychological investigation of the *existing* means of understanding. On this level of research the significist does not aim at formulating definitions the contents of which are detached from ordinary usage. On the contrary, at this stage he applies himself to examining and registering the verbal behavior of individuals and groups, considering its regularities and peculiarities, and aims at constructing a gradation founded either on a differentiation of the word-associations he observes, or on the nature and the number of indicative elements of the acts of communication performed by his "subjects," or on some other (e.g., logical) criterion. For the investigator himself such a gradation, whose successive levels may show a gradual increase of the indicative value of the terms introduced, may be a helpful means to get insight into the structure of pseudo-problems and pseudo-judgments (i.e., formulations which have the appearance but not the contents of indicative problems of choice or judgments of choice) and to recognize and to avoid circular reasonings if he wants to build up a scientific terminology suiting the aims he pursues.

The synthetic approach, however, confronts the significist with other problems. It aims, not at investigating, but at improving and extending the means of understanding in use. Although the synthetic gradation may be built on the analytic one, on the understanding that the terms of the "higher" analytic levels become basic terms of one or more of the "lower" synthetic levels, the synthetic definitions include new linguistic

means and as such have an artificial character. This may be illustrated by the following example.

In conversational language the word "instinct" often refers to a distinction between the actions of animals and men. No doubt this word is known to the readers of the present monograph, but it did not occur in the vocabulary they availed themselves of in their early youth. They have been acquainted with it by means of other words which they knew already at the time when they became aware of the term, and that not because they have learned a definition of the word, but inasmuch as they have heard it used in connection with the behavior of animals and men. However, the statement "animals are prompted by instinct, man is guided by his intellect" is not an *empiric* statement about animals and men, but a statement about the *usage* about animals and men, and in this form may give rise to all kinds of "terminological" questions and problems. The occurrence of indications or operations in the use of the word would place the term on another level of the analytic gradation.

The synthetic approach could start from the observation that some of the forms of behavior of animals and men, however complicated they may be, are characterized by a "typical" incipient and final stage (e.g., sneezing), whereas other forms show this typical character only in the incipient stage, but differentiate more and more in their final stage (e.g., flying), or conversely show a typical final stage (e.g., clutching at a prey). Viewed from a synthetic angle, the former group of phenomena might be called *instinctive actions* if they are brought about without the agent of observable stimuli, and *reflex actions* if such stimuli are present. The second group of actions (those with a typical incipient stage) might be named *actions of defence*, and the third category (those with a typical final stage) *purposive actions*.

Whether these terms correspond with those of the living language is an irrelevant question here. The main object of the gradation is that circular reasonings cannot creep into the descriptions and that questions referring to "instinctive actions" or "purposive actions" occurring with animals and men are made amenable to an experimental response.

In distinction to the analytic gradation, which is rooted in *extrospective* observation of language (the verbal reactions of others), the synthetic gradation, being an artificial construction, is anchored in the speaker's own language-sense, in his

own "nets of associations." To synthetic definitions criteria belonging to the word-family "efficient-non-efficient" may be applied, but not those belonging to the word-family "true-false."

Two other procedures have found acceptance in signific circles, procedures tending to recognize the "dispersion," i.e., the variability of the signification of words and word-complexes with regard to different individuals (*inter*individual dispersion) or to one and the same individual (*intra*individual dispersion): the *method of exhaustion* and the *method of transformation*. The former enables a signific investigation by comparing different situations which may give rise to the "same" verbal reactions, the latter by comparing different expressions aiming at rendering the "same" situation.

The acts of communication can be distinguished in those having a more or less *personal* and those having a more or less *impersonal* character. Impersonal acts of communication, having an indicative or physical value, are conveyable to a wider circle of hearers than emotive and volitive expressions and therefore can be investigated in a more formal way than the latter. The *mathematical-logical* or *syntactic-axiomatic method* lends itself best to studying the most impersonal or "objective" acts of communication, but is not qualified for an investigation into "subjective," emotive expressions. Between the "axiomatic" and the "introspective" level there is a variety of acts of communications which may be characterized by an increase of the personal element and to which a psychological method, like the signific one, can be usefully applied. In this connection it may be stressed that these distinctions, like any distinction of this kind, are artificial, and that the line between objective and non-objective acts of communication is often too sharply drawn: even in the "most objective" act of communication the volitive and emotive elements are not entirely lacking. Signific investigations show that there are impersonal, objective, "physical" acts of communication that have a much greater dispersion than one usually expects. It will be obvious that, generally speaking, a rather small dispersion has to be attributed to *proper names* and *technical terms* and that the use of *value judgments* is attended with a great dispersion of the terms involved, but it may be less obvious why the numerals "zero" and "one", in distinction to "two" and higher, differ in this respect, and why words like "perfect", "nothing" and "mathematics" belong to those having a great dispersion.

Confronting subjects with a number of visual situations (e.g., a photographic or kinematographic exposure) and asking them to interpret the latter, one can observe that it is rather difficult to choose pictures to which the subjects respond by the *numeral* "*one.*" "*A* house," "*a* dog," "*a* horse," may be the interpretation of three pictures which we pick out to that purpose, and only by showing a *series* of pictures (by which the counting is suggested) will one get the desired response: "*one* house," "*one* dog," "*one* horse." It will prove to be much easier to call forth the numeral "two" by the representation of an isolated situation; to this end it will be sufficient to show clearly any similarity, and a picture of "two houses," "two dogs" or "two horses" will probably lead to the desired result.

It is still more difficult to confront subjects with situations (or classes of situations) to which they respond by means of words like "zero" and "nothing." These words prove to be used to indicate a certain difference with regard to other situations, but have in themselves no indicative elements. The same can be said with respect to the so-called "Allaussagen," i.e., statements tending to denote the most general concepts. Apart from their sometimes mainly emotive functional elements, they, too, have no indicative signification and are almost exclusively used in a comparative way.

The method of *transformation* will often be useful to the investigation of the dispersion of the function of a word or of a group of synonymous words (word-family), especially where the dispersion has remained unobserved. This method particularly lends itself to revealing volitive and formal elements of acts of communication; the latter refer to elements bearing on *word*-associations only. One of the most simple transformations which can easily be applied to acts of communication of daily and public life is that from the approving into the disapproving terminology. It will be evident that words like "heroic" or "reckless," "laudable" or "blameable" do not refer to a clearly defined situation but vary according to the approbation or the disapprobation of the speaker. It is not difficult to see either that questions referring to "justice" or "injustice," "freedom" or "coercion" can be reduced to the "positive or negative charge" of the "same" representations of different persons, but it may be less easy to understand that this personal element sometimes plays an important part in all kinds of divergences of opinion of a more scientific nature. Neither speaker nor hearer always recognizes the volitive element un-

derlying many social, political and economical problems, even though the latter refer to situations in which they are involved. Moreover, we all have a tendency to give our valuative, subjective judgments the appearance of distinctive, objective judgments, the latter being more conveyable than the former ("it is . . ." instead of "I think it is . . .").

From the above explanations it follows that statements which do not contain experimental, verifiable observations are not at all immaterial in the eyes of the significist. On the contrary, he regards volition and emotion as the fundamental elements of every act of communication, although he does not disregard the important part the indicative element (the only one which can be related to the concepts of "experiment" and "verification" in a physical sense) plays in more or less impersonal communication.

From a "macroscopic" point of view, both personal and impersonal acts of communication greatly differ in their volitive value. From the beginning, significs has accentuated this aspect of the "problem of the pseudo-problems." For this kind of "pseudo-problems" (*Mannoury* has called them *unreal pseudo-problems*), although they may often have the appearance of indicative, distinctive problems, should be sharply distinguished from those statements which, after being subjected to a terminological transformation, prove to be "lacking any sense". On the other hand, there are problems of a purely terminological nature whose statements can be reduced to formal elements only; to them belong the problems of formalistic mathematics, but they will not give rise to misconceptions, unless their formal character has remained concealed; in other words, unless they are "real pseudo-problems."

In general, real pseudo-problems are not easy to investigate and often require an exact analytic study of the dualistic character of colloquial language ("I-it-transformation") and of the subtle structure of mental processes, the description of which cannot dispense with new linguistic means ("micro-psychological" terminology).

In some cases it may be useful to introduce a micro-psychological, a micro-logical or another micro-terminology — unified and formalized terminologies — as the starting-point for further formalization; in this way endeavors have been made by significists to anchor fundamental mathematical concepts in a micro-psychological terminology.

Especially in tracing the indicative elements of emotive and

volitive acts of communication, the operational method, requiring descriptions which take their contents from the concrete operations that enter into the definitions of the concepts employed, has also proved to be very helpful. By giving an "operational meaning" to terms like "freedom," "determinism," "justice," "state," etc., these terms get a more or less indicative sense.

The *analytic* signific approach may be best effected in an experimental way and with the aid of many subjects and many observers. To results which are obtained introspectively only a minimum value may be attributed. It goes without saying that the methods described in this chapter should be applied without preconceived opinions. The establishment of the reliability of a "signific test" does not differ essentially from the establishment of the reliability of a psychological test or "type of observation" in general, although signific investigations in their statistical approach, especially in the domain of values, meet with particular difficulties (see also Chapter III).

III. Applications

The methods and principles set forth in the preceding chapter have found application in various fields of science: in mathematics, in logic, in physics, in linguistics, in psychology, in biology, and in the social sciences. Not only some of the fundamental concepts of these sciences have been subjected to a signific analysis and the usage in different scientific circles has been studied, but also new terminologies more useful than the existing ones from a signific point of view have been constructed. The first part of a signific grammar for the use of college pupils has been recently written.

The application of significs in the field of mathematics is founded on the distinction between *mathematics in a more limited sense*, referring to the verbal expression of the mathematical science, and *mathematics in a wider sense*, bearing on the system of mental associations underlying the outward symbolic appearance (*formalistic* and *intuitionistic mathematics*). The formalistic expression of the "law of constancy" (*Mannoury*), being the foundation of mathematics in a more limited sense, is the principle of identity ($a = a$). The signific approach aims at finding out the kernel of the complexes of mental reactions that give rise to those acts of communication which are known as mathematical. This relativistic point of view differs in many respects from the traditional one.

In colloquial language the signification of a term like "infinite" is of an emotive character; in formalized mathematics it is purely formal. On this consideration is based the conception that in the theory of sets those statements referring to *infinite sets* on the one hand and *empty sets* on the other, in other words, the statements which in defining these sets require the *negation of exclusion*, exclude a physical correlate. For terms like "infinite," "general," "empty," "real," "eternal," "material," "I," belong to a group of linguistic forms, which may be called the linguistic form of *generality,* and which are connected to the negation of exclusion by the formula "*a* or *non* = *a* = everything" (principium tertii exclusi) and "*a and* non = *a* = nothing" (principium contradictionis). In distinction to the *negation of choice,* bearing upon statements with a mainly indicative signification (distinctive propositions), the *negation of exclusion* refers to statements of a mainly emotive, in particular, declinatory character.

Every linguistic level may be called formal as far as it gives expression to the speaker's associations with other *verbal* associations. And *every* linguistic level may be called spontaneous, meaning that the particular form of every act of communication is determined by the state of mind of the speaker at the time when the act is performed. Considering this, one could say that there is not an essential but only a gradual difference between mathematical and non-mathematical language.

"Demonstrating," "refuting," "deducing," and the like are terms which formalistic mathematics has taken from conversational language, without parting them entirely from the emotive and volitive elements characteristic of these terms in colloquial language. Such a mixed language occurs where a branch of science does not rest upon a far-advanced formalization of language and where the signific foundation did not precede the axiomatic one.

Two ways may be followed to define the concept of mathematics. The *analytic* definition could be derived from the usage of the ordinary mathematical terminology. But this terminology varies greatly, not only from individual to individual — the controversy between intuitionists and formalists is to a large extent attributable to these variations — but also with regard to one and the same mathematician. Therefore, let us try to define this field of science in a *synthetic* way. Leaning on our own verbal associations, we can map out the domain of mathematics and compare it with the corresponding empirical

contents. In this sense thus, according to our subjective language-sense, we can establish that one speaks of formalized mathematical language when the hearer's linguistic reaction to the speaker's act of communication is as independent as possible of the persons involved and of the circumstances under which the act is performed. It is obvious that this synthetic formulation is characteristic of the usage of certain *groups* of persons and that even in this limitation it contains many more elements than what is usually called mathematics. Many people will reply in a similar way to the question: "What is the first letter of the alphabet?" or to the question: "What is the sum of three and five?", although few people will say that the former question belongs to the field of mathematics. In eliminating the "circumstances," we have excluded the physical language from the domain of mathematics.

The more the signific procedure develops in a synthetic direction and the new linguistic forms get a formalistic character, the more it approaches the axiomatic method. However, from a signific point of view, the deeper significance of mathematics lies in the progress of the analysis to which human language and human thought are subjected. And from this analysis, too, it takes its (relativistic) "general validity."

In this connection some consideration may be devoted to the theory of probabilities. From a signific angle, a distinction should be made between the *mathematical* and the *applied* theory of probabilities. The former can be entirely formalized and axiomatized and, consequently, does not have other signific foundations but the mathematical formalism in general. As to the *application* of the theory of probabilities, however, one should distinguish between the finitistic and the infinitistic theory of probabilities, the former being applied to the concept of "probability," which in most cases refers to expectations concerning future events, the latter differing from the finitistic one, inasmuch as it applies the negation of exclusion in defining the chance-number 0 as a result of limit-transition. The difference between the notions of the finite and the infinite is of a purely emotive character and cannot be defined in terms of (real or hypothetical) experiments. The endlessly discussed question whether $P = \frac{E}{N}$ tends to a limit with N increasing ad infinitum or not arises from the mixing up of those two elements in the meaning of the word.

The mathematical form of thought in a more limited sense distinguishes itself from other forms of thought by a formalistic feature and a more explicit gradation of the significations introduced and by the isolated character of the "net of associations" which is characteristic of this mode of expression. All formal-mathematical systems underlie the (mostly implicit) assumption that from the beginning all uncertainty and all indefiniteness are left out of consideration. The weak point of the "proverbial" form "two times two is four" lies in the untenableness of the arithmetical rule to which it can be reduced: "1 = 1," a sequence of "words," the psychic correlate of which cannot be designated with "mathematical certainty."[3]

Although the *formal* syllogism can be said to belong exclusively to scientific usage, yet this form of reasoning is not alien to common parlance. In the latter case we have to do with a transfer from a more *general* expectation to a *particular* perception ("all negroes are unreliable," "this man is a negro," "consequently, this man is unreliable"). But also the reverse phenomenon occurs: the extension of a particular emotion to a more general one (major: "This man is unreliable," minor: "this man is a negro," conclusion: "all negroes are unreliable"). Expressing ourselves in a signific terminology, we can describe these processes of deduction and induction as *mental phenomena of pulsation aiming at translating emotive*

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[3] A striking similarity of views we find in the writings of *P. W. Bridgman* and in those of *Arthur F. Bentley.* "We have come to expect by now that when we push our analysis far enough we can uncover imprecision and uncertainty. This is also the case with the human enterprise of logic. Consider a simple syllogism in the conventional form 'If all a is b and if all b is c, then all a is c.' In this syllogism the same symbol, 'a' for example, occurs twice. Now 'a' stands for something — the fact that the symbol occurs twice implies that it makes sense to speak of the referent of 'a' remaining the 'same' during the progress of our discourse. What does it mean to say that the referent remains the 'same' during the discourse, and how shall we check on any tentative referent to insure that it really has remained the same? 'Sameness' is by implication a word of absolute precision, and we know that we never experience such. It must be that many ordinary referents have the property of 'sameness' to a sufficient degree to justify their use in a syllogism. But what is the criterion that they possess it to a 'sufficient' degree except the criterion that the syllogism gives the correct result when we assume it? I think there is no other answer and that the syllogism always conceals a certain degree of circularity". (*P. W. Bridgman,* "Some Philosophical Aspects of Science," paper to be published in *Synthèse.*)

and indicative experiences and recollections into expectations of a more narrow or a more wide bearing (the "process of regrouping," *Mannoury*).

It is true that the development of the symbolic and pasigraphic method has enabled us to bring essential parts of classic and more modern systems into a deductive form, but this does not imply that for the significist the fundamental difficulties resulting from the formalizing of "living language" are now solved. He has observed the phenomenon that the "higher" logical linguistic levels lose their suggestive power, i.e., their usefulness with regard to the conveying of mental contents, according as they increase in regularity. From what has been said it results that the main signific problems lie here in the zone of the transition from conversational language to formalized language, and vice versa (the "switching in" and the "switching off" of a formalistic system). Questions like "How far is it possible to express mathematical thinking by means of pasigraphic systems?" and "Which are the foundations of such a symbolization of mathematical thinking?", which have been raised in signific circles, confront the significist not only with problems of observation of language, but also with those of experimental psychology.

It may be said that *Brouwer's* mathematics, by analyzing and limiting the validity of the principium tertii exclusi, has made mathematics applicable to "spheres of life" which have been unaccessible to classic logic and that this mathematical intuitionism, even in its formalized expression, is much more close to living language than the logistic system of *Peano-Russell.*

In the domain of physics signific studies so far have mainly concentrated on the analysis of some fundamental concepts, such as "time," "space," "motion," and on problems of a more epistemological nature: "causality," "continuity," and the like. From a signific viewpoint, the notions of causality and physical law are nothing but the general and particular expressions of the regularities representing in most cases the associations recollection of expectations — observation (*empirical contents or indicative signification of the physical laws*), and, on the other hand, the corresponding regularities of the associations recollection of observations — expectation (*emotive and volitive signification of the physical laws*). An *objective* content, in the strict sense of the word, i.e., a content independent of man, could not be attributed to physical laws, inasmuch as they are in the last resort psychological laws; they

exercise a great influence on human life also because their knowledge facilitates the transition from "end to means" (*Brouwer*).

The problem of causality refers to the question as to the psychic correlate of the family of words to which terms like "cause" and "effect" belong, and a signific investigation into these terms shows that they do not contain a more or less definite complex of representations or affections, but that they consist of what may be called a network of associations or correlations which find expression in conversational language by words like "in consequence of," "by so doing," "because," etc. In the most striking cases the causal "ordinative" principle bears on associations between sequences of recollections and sequences of expectations of an *indicative* nature: I remember having seen a certain sequence of phenomena and expect to observe the same sequence of phenomena in future. Wondering what, from this point of view, is the signification of what one calls the *general* principle of causality or the *general* law of causality, we will reduce this principle to a twofold empirical rule, expressing on the one hand that *my* expectations (and, as far as I can see, also those of my fellow-men) usually more or less agree with a certain average of resemblant sequences of images of recollections, and, on the other hand, establishing that, as far as I remember, my experiences in the past were in agreement with what I had expected a moment ago ("law of regrouping" and "law of prediction," *Mannoury*).

It is evident that this signific interpretation differs greatly from the absolutistic conception speaking of an "unshakable" and "generally valid" regularity to which all phenomena inexorably are submitted, and that the difference between the two conceptions can only be expressed in emotive terms. The question whether the above principle of causality has a general validity or not is regarded by the significist as a purely terminological question.

It goes without saying that the concept of "matter," of "lifeless substance," as element of a conception of the world, has also been subjected to signific criticism. It has been replaced by the representation of a sequence of phenomena or *events* which, from a human point of view, may be regarded as elementary, and attempts have been made to formulate a theory according to which spatial and temporal relations are made subservient to those between the events, the "flashes" (*Van Dantzig*).

However, the influence of the American operationism has left its traces in signific circles these last years, and some of the conceptions prevailing there can be rendered by the following quotation taken from *Philipp Frank's Modern Science and its Philosophy* (p. 295): "From a psychological viewpoint Einstein describes this way of producing theories by free imagination in a letter to the French mathematician Hadamard. According to this new conception, it is true that physical theories are the product of free imagination, if we take the word "free" with a grain of salt. But it must not be concluded that these theories are products of metaphysics. For these theories are subjected to the operational or experimental criterion of meaning, though in a more indirect and complex way. The criterion of truth remains ultimately with the checking by sense observations, as the older 'positivists' claimed. But we know now that this checking is a more complex process than it was believed by men like Comte and Mach to be."

Carnap has defined the "meaning" of a statement in science as the sum of all statements about similarity and diversity between sense impressions that can be derived logically from the statement in question. (*The Logical Structure of the World.*) "Operational definitions" enable us to derive from the symbolic system observational facts that check with our actual observations; they are the descriptions of the operations by which abstract symbols (e.g., the space-time co-ordinates) are connected with observational phenomena. According to *Bridgman*, a theory which does not contain the operational definitions of its abstract terms is "meaningless". Like the significists, *Bridgman* pays attention to the *circumstances* under which acts of communication are performed, and we may say that his conceptions and views have been most favorably received in signific groups as a means to avoid confusing discussions about theory construction, also in the field under consideration. That the structural definitions are bound to logical and practical limitations, has been particularly stressed by *Clay*, who has pointed out that in the development of science there is not only a regression of the *unstructural* on micro-levels of observations, i.e., the possibility of giving structural definitions of micro-processes, but that there is also a regression, in the opposite direction, of the *structural*, i.e., of the possibility of describing a macro-complex as an element of a more complicated structure.

In biology the object of significal investigations has been

from the beginning the critical study, both from a logical and from a psychological point of view, of the fundamental concepts of the various departments of this science. It was evident to the significists that many of these concepts, especially those occurring in speculative biology, urgently need such a study, as emotive and volitive elements are often abundantly represented in the terminology of speculative biology. The recognition of these elements is essential for a clear understanding of many problems in this field; their elimination, by an attempt to formalize the concepts used, was considered to be a useful means to avoid endless and fruitless controversies on pseudo-problems.[4]

It may be stressed that the object of these activities is the *study*, not the fixation of biological concepts; their purpose is informative, not normative. Science is like a living and growing organism; its conceptual apparatus is developing with its progress. A premature fixation of the meaning of concepts would inhibit this necessary development. Therefore, one has to restrict oneself to the attempt to determine and to formulate as accurately as possible the meaning of a concept at the time being; to recognize its eventual irrational elements; and to eliminate these elements, as far as possible, by a formalization of the concept. It is essential that the way in which the concept can be applied to the empirical objects of science be clearly indicated, and that the further development of the concept is given space.

Instead of subjecting some concepts of speculative biology to a critical analysis, e.g., those of "wholeness," "plan," "design," "entelechy," etc., the biological section of the group of significists followed another procedure. The nature of the phenomena to which most of these fundamental concepts of general biology refer can only be understood if agreement exists about the meaning of other notions belonging to the field of empirical biology. It was necessary, therefore, to begin with the study of these concepts of less wide scope, but more immediately related to the empirical data of biology. Only when, in this way, the fundamental concepts of the various branches of empirical

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[4] See also the general survey of the activities of the Biological Section of the International Society for Signifies, by *Chr. P. Raven, Synthèse,* Vol. VII, Nos. 1-2, p. 93 ff., from which the particulars of this part of the monograph are taken.

biology have been examined, a sufficient basis is formed, from which one may endeavor to get an understanding of the fundamental questions and notions of general and speculative biology.

The study of the concepts of *descriptive* biology had to be preceded by a discussion of description itself. The relations between reality, perception, observation and description were discussed. Every description is adapted to a certain purpose, and does not satisfy other purposes; no description can be complete in itself. The elements of description are the properties imputed to the objects described; they can be classified as quantities, qualities and arrangements. In these discussions a remarkable difference with regard to the views on the relationship between the concepts of "property" and "characteristic" came to light. The biologists were inclined to define a "characteristic" as a special property, being important enough to be used for the recognition of the object to which it belongs. For the physicist who took part in the discussions a "characteristic" was a superficial feature of the object, and had nothing to do with its "properties," the latter concept denoting the fundamental elements of its nature. Evidently the difference in significance attributed to these words is due to psychological factors; they have not further been studied.

In biology description makes use of biological notions at first; with the progress of analysis, these are reduced more and more, however, to arithmetic, geometric and physico-chemical notions. The properties of arrangement or structure are very important in biology; spatial and temporal structures may be distinguished. With regard to spatial structures, the problem of elementary units in biology and the concepts of unity, individuality and wholeness were discussed. The study of temporal structures involves the concepts of causality, law and rule, whereas a consideration of the spatio-temporal structural relationships as a whole brings to the fore the concepts of design and sense. "Causality" and design do not exclude one another, but are complementary.

After ample discussions on the concepts of *systematics, species, race, phaenotype* and *genotype* and on some fundamental concepts of comparative anatomy, the part which the concept of *type* plays in anthropology (e.g., racial and constitutional types) was examined. It was argued that a system can never be a complete expression of phylogenetic relations, as the latter have another dimension, including the factor "time." The resemblance between the hierarchic grouping of classification and

the genealogical tree of phylogenetics is only a superficial one; it may seduce to overlook the essential differences.[5]

These discussions were followed by a critical examination of the concepts of those parts of biology that study the vegetal, animal and human communities. Only part of this program has been completed by now, as only the concepts of phytosociology have been discussed. The notion of "plant community" implies the existence of mutual relationships between the members of such a community; they can be summarized by the concepts of "competition" and "priority," and give rise to a social structure of the community. The concept of "competition" was defined as the mutual influence between equivalent plants having similar necessaries of life, thereby restricting each other in their ability of expansion. Whereas a "plant community" is an abstraction, the concrete samples of vegetation may be indicated as "populations" or "phytocenoses"; they are distinguished by the fact that phytocenoses possess a social structure, whereas this is lacking in a population. It was emphasized that the word "phytosociology" is misleading, as fundamental differences exist between the plant communities and the communities (societies) of man and higher animals, which are studied by sociology.

In the course of these discussions many concepts of a more general nature, like those of causality, probability, chance, finality, order, purpose, wholeness, have been touched upon. The existence of three leading ideas in biology has been stressed on many occasions: 1. the causal idea, bearing on the relations between mentally isolated events; 2. the historical idea, relating the phenomena to the single irreproducible series of real events called history; 3. the final idea, bearing on the relationship of the phenomena within a living, a biological, system to common space and time coördinates. It may be expected that it will be possible by clearly distinguishing between these complementary and equivalent ideas, to attain a certain degree of formalization of many of the fundamental concepts of biology.

"Significs makes a study of the effects on human behavior of the linguistic aspects of the evaluative process, the most distinctly human aspect of the behavior of the human organism."[6] This definition, given by *Anatol Rapoport* at our Fifth Inter-

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[5] For further details, see *Chr. P. Raven*, l.c.

[6] *Synthèse*, Vol. VIII, Nos. 3-5, p. 193.

national Signific Summer Conference, certainly bears on one of the fundamental aspects of the signific approach. It makes clear why the significists are particularly interested in some fields of inquiry which have implications for their special discipline. As such may be mentioned *Cybernetics, Mathematical Biophysics* and the *Mathematical Theory of Communication,* in which, as in significs, the word communication is used in a broad sense to include all the procedures by which one mind may affect another. Two of the three levels at which *Warren Weaver* considers the general communication problem, viz., the level referring to the question, how precisely the transmitted symbols convey the desired meaning (the semantic problem), and that bearing on the problem, how effectively the received meaning affects conduct in the desired way (the effectiveness problem), are specific signific problems.[7]

Starting from a simplified schema of cellular occurrences, *mathematical biophysics* aims at mathematically deducing experimental results in the field of higher mental functions with considerable specificity and accuracy. The understanding of the events in the nervous system and analogous systems as determined by their structure is claimed to be fundamental for the understanding of abstraction, evaluation and communication — processes of basic importance in significs. On the basis of *Rashevsky's* picture of the nervous system it would be possible to describe quantitatively such relations as reaction time as a function of the interval between a preparatory "warning" and the stimulus; acuity of discrimination as a function of the magnitude of the stimulus, and many other relations. The approach may also be useful in suggesting "models" to account for a wide variety of "psychological" phenomena, such as conditioned reflexes, error elimination (as observed in maze learning), logical "thinking," visual perception and esthetics, and some psychotic states. The theories regarding the construction of electronic computers and calculating machines from the point of view of invariances involved in such devices have been received in signific circles with vivid interest. And this is obvious. The study of the linguistic aspects of evaluative processes — one of the items of the signific program — is closely connected with that of the events associated with evaluative processes, which mathematical biophysics seeks to describe in physico-

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[7] *Claude E. Shannon* and *Warren Weaver,* "The Mathematical Theory of Communication," The University of Illinois Press, Urbana, 1949.

mathematical terms, and also with the invariants common to these other processes, which cybernetics try to discover. The words of Weaver that "one has the vague feeling that information and meaning may prove to be something like a pair of canonically conjugate variables in quantum theory, they being subject to some joint restriction that condemns a person to the sacrifice of the one as he insists on having much of the other," have not escaped our attention.

In this connection special mention may be made of *Charles Morris'* semiotic with its main subdivisions: *semantics, syntactics* and *pragmatics.* The reader of the present monograph who is acquainted with Morris' science of signs will have noticed the similarity between his conceptions and those of the significists.

In the field of *sociological* studies, taken in the sense of scientific studies of the phenomena arising from, and conducive to, social interactions and interrelations, significs has also to accomplish the double task of clarifying the conceptual framework of existing terminologies and of providing the sociologist with a procedure for the construction of his theories; in other words, to furnish the means for a foundation of a scientific sociological terminology. Sociologists often do not express themselves clearly, because they neglect the task of introducing exact definitions and making linguistic analyses, and, in default of this, avail themselves of abstractions devoid of all indication. Operational definitions, dealing with concepts which are construed of operations, have proved to be a useful means to link abstract words with our experience.

According to the significists, language is one of the most important social factors; it is underlying every study of the individual and the group, of the family and other social organizations, science, jurisprudence, art and war. Sociology in itself and by itself gives a strong impetus to significs by studying the conditions under which signs and symbols have a "meaning"; by examining human responses to signs and by examining the relations between language and human behavior.[8] The connection between sociology and significs is evident. The significist has learned from his observations that often differences of a terminological nature separate different conceptions: in

[8] This is also an item of the program of the General Semanticists, whose writings have been and are being carefully studied in some of our groups. In Great Britain similar studies have been undertaken by the jurist *Alvin C. Leyton* (London).

politics, in sociology, in philosophy, in the theories of the foundations of science. Each trend develops its own usage, its own idiom, which easily gives rise to misinterpretations by other trends. Moreover, not all authors distinguish clearly between their own opinions and emotions and those they ascribe to members of a community.

In the social sciences significs has been applied partly to sociological techniques and study methods and to the recording of observations of language, partly to investigate the relationship between language and human behavior, especially the influence of language on the creation of beliefs, ideals, and aspirations. For that purpose significs aims at studying problems with regard to social control: the several types of norms regulating and controlling behavior (convention, fashion, religion, morals, law), and at investigating the social processes, the various forms of interaction between individuals and groups, including social differentiation and integration.[9]

The signific approach places before the sociologist the question whether the acts of communication he is investigating bear upon a concrete situation or not. For the main aim of his investigations is to record the verbal or non-verbal responses of individuals and groups to verbal or non-verbal stimuli, and to analyze and to classify them. If the significist is not able to confront his subjects with observable situations, or in general to record reactions to concrete situations, he will have to get on with collecting and analyzing texts, quotations from the press, radio, etc., referring to the situation in question. This material might be the expression of the representations of a certain individual or a certain group, but might also be the symptom of a certain state of feeling or disposition of the individual or the group. In this case he is only indirectly in a position to choose his subjects; he does not know whether the groups he is examining are homogeneous, or in which respect they are homogeneous, and whether the specimens, especially if they bear upon judgments of value, are representative of the whole group. His task is to trace the correlations existing between the usage of ideological, political or other groups and the social and political aims predominating in such groups.

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[9] Basic research of this kind has also been carried out by the Institute for Social Research at Oslo. The purpose of the Institute is to conduct and encourage coördinated research in the fields of Sociology, Social Psychology and Social Anthropology.

He should beware of the danger of examining a single emotive term, for a signific investigation of emotive terms should embrace the whole of interrelated terms bearing upon the concepts to be investigated and should not confine itself to one or some terms which may be easily used as slogans.

Failing a concrete situation the significist has to develop a special technique. Distinguishing different linguistic levels — a linguistic gradation which, as we have seen, is characterized by the fact that words and expressions of a certain level (which of course is not the primitive level) can be replaced or described by terms of the preceding level — he may ask the question: on which level the act of communication he is investigating can be placed. In general it may be said that this will depend upon the amount and the nature of the indications the act of communication contains or the operations to which it refers; the conditions under which the terms are used and the state of development of the language-sense of the subject.

In order to trace the psychological background of acts of communication, the mental associations which are characteristic of their use, the significist will study: (1) the circumstances under which the words are used; (2) the elements and the character of the groups who avail themselves of them; (3) the purpose(s) these groups have in view by using these words; (4) the circumstances under which they avoid explicitly or implicitly the use of certain words or expressions; (5) the social, ideological and political conceptions prevailing in these groups; (6) the question whether the words belong to the "group premises," i.e., to the net of associations that is basic to the judgments accepted implicitly or explicitly by the group; (7) the more or less emotive, volitive or indicative character of the words; (8) the variability of the signification (dispersion) of the expression and its positive or negative emotive value according as it is used by a group or by another (adversary) group; and (9) the operational contents of the act of communication, i.e., the actions which it describes or to which it refers. Certainly, such investigations are long-winded, but urge themselves upon those investigators who will not be satisfied by quasi-scientific results.

To that end one can make use of questionnaires. But in this case one should observe the fact that purely verbal results will be easily obtained, since usually the questions do not confront the subjects with concrete situations and often contain emotive expressions. More often than not, the words used in question-

naires not being analyzed beforehand, the questions anticipate the results of the inquiry and neglect the non-verbal responses of the subjects. The means introduced to parry this inconvenience by "cross checks" — mostly of a verbal nature too — at best only partly succeed in breaking through the chain of verbal associations. In this connection it may be noted that material conflicts — conflicts of interests — often screen themselves behind ideological conflicts.

The results of sociological investigations are frequently influenced by subjective appreciations of which the investigators are not conscious, but which may give rise to partial judgments. In particular they should beware of the procedure to trace certain properties of any fragment of a population and to attribute these properties to parts of the population which have not been investigated. Viewed from a taxonomic angle, generalizations of this kind should not be based upon a specimen which is not representative of the group under examination. Sociological studies should clearly distinguish moral appreciations, philosophical theories, and scientific facts. Their records should mention how individuals and groups behave and not how they ought to behave. Significs studies of the impact of the language of a group upon its members, particularly of industrial and political groups, have revealed much of the source of disintegration within society, and of conflicts, actual and potential.

The theoretician's own verbal behavior is often included in the "material" he investigates. If we call object-language the language used in verbal behavior of people which sociology investigates and meta-language the language sociology uses in its discourse about the verbal behavior of people, it becomes fairly obvious that in present-day sociology the two languages are still inextricably mixed together. On the other hand, people whose behavior is being investigated often use terms and meanings of the meta-language together with those of the object-language. The sociological meta-language thus becomes a meta-meta-language, and so on.[10]

All these investigations form part of analytical significs, of extrospective observation of language, the principal aim of which is to investigate the current usage. However, when building up a synthetic vocabulary, the social scientist has to face other problems, but, apart from the specific character of the subject-

[10] See also *Vladimir Cervinka*, "A Dimensional Theory of Groups," *Sociometry*, Vol. 11, No. 1-2, 1948 (Reported by *Stuart C. Dodd*), and *Vlad. Cervinka*, "Factor Analysis," *Statisticky obzor*, roč. 1948, č. 2.

matter, these problems do not differ from those referring to the construction of a synthetic gradation in general. For scientific sociology the construction of such a useful terminology will be an indispensable although laborious task requiring the collaboration of a staff of specialists in various fields. For one should not forget that scientific method depends on the refinement not only of our physical tools but also of our conceptual tools, not only of our experimental apparatus, but likewise of its language of statement and definition.

Considering the foregoing explanations it may be clear that *psychology* is playing an important part in signific studies. The conceptual framework of significs is to a large extent a psychological one. The significist avails himself of current psychological concepts, like emotion, volition, representation, expectation, recollection, impulsion, thinking, believing, etc. If significs enters in this way the scope of psychology, psychologists and psychiatrists, on the other hand, are confronted day after day with signific problems. In the relation psychologist-subject or psychiatrist-patient the apparatus of communication fulfils a considerable, if not a prevailing, function, while the kernel of the signific study, on the analytic side, lies in an investigation of the elements underlying communication. In psychology many terms have as their referents complicated actions, habits and dispositions; for this reason they can be introduced only as a starting-point for the analysis of complex behavior. Moreover, vernacular and technical terms are often confused. In front of this situation significs aims at constructing a micropsychological terminology for describing phenomena of observation, a terminology which, in describing the processes of auto- and hetero-introspection, will take care of finer distinctions and consequently, in this respect, will be more useful than the current one. The question has been raised how far the vernacular may be efficiently used in theories aiming at predictions of behavior in unstandardized complex situations of "real life," since on higher levels of precision and reliability the undesirable properties of the vernacular tend more and more to obscure statements and make partial elimination of them necessary.[11]

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[11] See also *Arne Naess*, "Notes on the Foundation of Psychology as a Science," Mimeographed Copy, Oslo, 1948; and *Egon Brunswik*, "The Conceptual Framework of Psychology," The University of Chicago Press, 1952.

On the macro-psychological level operational definitions are introduced to give an "operational sense" to the vernacular terms, which are used to describe the correlations between mental and linguistic phenomena. On the other hand, the significist tries to translate metaphoric descriptions, so abundant in psychiatric and psychological literature, into behavioristic ones or, in fewer cases, to translate descriptions formulated in the it-language into those in the I-language. Records in this field, even those made by experts, are written too often on a level of language lying far above that of the vernacular and contain terms which, unjustly, are being supposed to belong to the idiom of the "hearer" and to be "understood" by him, although they are not rooted in indications or operations.

Besides, within the scope of signific studies, psychologists have been trying to trace the characteristics of the language of psychotics and neurotics comparing them with those occurring in acts of communication performed by "normal" adults and children under similar circumstances; among others with the aim of getting insight into the origination and the development of pseudo-problems and pseudo-judgments. To that end they study the way in which statements are verified in pathological behavior and in which both pathological and normal behavior are justified. In this connection special attention has been paid to the use of metaphors and generalizations (Allaussagen). The problem whether it would be possible to give the concept of "psychical strata" a more indicative signification by relating — as far as the conscious levels are concerned — certain mental phenomena to certain linguistic levels, a research requiring many observations of linguistic behavior, is one of the items still under discussion.

IV. Concluding Remarks

Logical Empiricism, Operationism, Pragmatism, Semantics and Significs — they all have tried to set up criteria by which one can distinguish clearly between "meaningful discourse" and "empty talk." Like pragmatism and operationism, significs lays stress on the conception that the "meaning" of a statement is characterized by the way in which it influences the behavior of men who are trained to react to the language in which the statement is formulated. Logical Empiricism, like significs,

stresses the importance of the analysis of our language tools for a comprehensive "scientific attitude."[12]

The different approaches to language- and concept-criticism of the last decades may be roughly divided into an analytic one, an axiomatic one and a signific one. *Bentham*, *Ogden* and *Richards* may be regarded as the authors who have inaugurated the analytic area; who have pointed out the variety and variability of the significations in colloquial language; and who have shown that the mixture of mainly emotive and volitive elements by which the language of everyday speech is characterized is not suitable to the purpose of useful communication.

The second trend of present day criticism of concepts we have in view, the axiomatic one, finds its exponents in those scientists who do not confine themselves to the "negative," analytic side of the criticism of language, but who aim particularly at constructing logical systems, where possible in a pasigraphic form. Among them are logical empiricists who, just as the significists, have paid special attention to epistemological problems and have subjected the current philosophical theories, abounding with metaphors and generalizations, to a sharp criticism.

We have another aspect of similarity in view when we mention here the operational and the pragmatic approach to "meaning," and in connection with this, the General Semantics Movement, for whom the study of symbols and the inner reactions to symbols are important objects of study.

Both the logico-empiristic and the signific movement have empirical tendencies, although they have not developed the same procedures, even with respect to their criticism of language.[13] The substitution of philosophy by a logical analysis of language is not one of the items of the signific program, which aims at clarifying the "problems of life" by modern psychological means. The significists do not exclude from their discussions problems belonging to the "domain of will," but they try to reduce them to their psychological elements. They have not drawn up an *index verborum prohibitorum,* based on the refusal

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[12] The history and the development of Logical Empiricism and its significance for present-day science has been clearly deserbed by *Philipp Frank* in his book "Modern Science and its Philosophy", Harvard University Press, Cambridge, 1949.

[13] See also my article "The Psycho-Linguistic Movement in Holland," *Philosophy of Science,* Vol 18, No. 3, 1951.

to admit certain terms and expressions to science and philosophy. Both movements aim at unmasking pseudo-problems and at building up an efficient terminology. However, the significists, availing themselves of psycho-linguistic means, distinguish between "real" and "unreal" pseudo-problems; after being subjected to a terminological transformation the latter prove to have an emotive or volitive "meaning" (conflicts of will). Both the logical empiricist and the significist assume that one of the causes of the careless and naïve usage in science is the inaccuracy of common language which, among others, leads to the temptation to substantialize many terms. The significist especially emphasizes the dualistic and mixed character of colloquial language and the value of introspection as a scientific method aiming at recognizing subjective mental elements which, however, can be objectivized ("intersubjectivized") by comparing the introspective results obtained by a staff of scientifically skilled introspectors. This should not be misunderstood. With regard to analytic significs, which aims at registering, studying and analyzing the linguistic behavior of "others" (heterospection), introspection can have only a very restrictive, and mainly comparative, value, but in the synthetic signific approach, the construction of a new terminology, the introspective element occupies a prominent place. And the investigation of these introspective elements underlying acts of communications on synthetic levels belongs also to the field of signific studies. By claiming a multilateral elaboration of the results of investigations (i.e., an elaboration by individuals belonging to different ideological and social groups) the significist also tries to satisfy the condition of "objectivity," in the sense of "intersubjective observational reliability." In other words, he tries to get classes of responses yielding maximum reliability coefficients between individuals facing common "geographic" situations or situational elements.[14]

The signific method may be called an empirical method, as it is based on observation. It tries to penetrate the psychological background of the linguistic behavior; *as such* it does not study, as semantics (in the logical sense of the word) does, the *form* of semantic antinomies, the methods of arithmetization, the theorem of indefinability, and the like. Logical empiricism aims either at a logical analysis of the scientific language (*Neurath, Carnap*) or of all forms of language (*Frank,*

[14] Cf. also *Egon Brunswik,* op. cit., p. 11.

Schlick, Von Mises, Morris). According to the significist, criticism of language is not synonymous with logic of science. He aims at analyzing the functional elements of acts of communication, although he does not emphasize the difference in logical grammar of each of the forms of language.

Much of the clumsiness and confusion of argument can be removed by formalization. But significists do not lose sight of the fact that one can tell highly speculative stories by means of symbols and that sometimes a symbolism may even conceal the ambiguity of certain explanations and distract the attention of scientists who are accustomed to rely on symbolic argument. Moreover, in many cases it will be more efficient to investigate *why* and *how* the words are used; in other words, to consider the circumstances and the influences of environment under which acts of communication are performed, rather than the communication itself (*symptomatical signification of an act of communication*). The study of non-verbal responses to non-verbal or verbal stimuli, the investigation of which requires a special technique, therefore forms an integral part of the significe program.

In this chapter we have tried to summarize the empirical and critical tendencies of the significe movement and to indicate the similarities and differences of these tendencies with regard to those of some related critical movements. Present-day significists acknowledge the necessity of devoting their attention, in addition to concept and content analysis, to the improvement of the means of understanding in use, both in science and in daily life. They do not deem the analytic method to be of less importance than before, but the synthetic application of the significe principles to the various "spheres of life" has come more and more to the fore. Notwithstanding its somewhat heterogeneous structure, entailing differences in accentuation which tend to guard against one-sidedness, the significe movement strives after unity of method and the cultivation of attitudes of thought such as will tend to unity.

V. Historical Development

The term "significs" was introduced by *Lady Victoria Welby* to denote "the study of the nature of Significance in all its forms and thus of its working in every possible sphere of human interest and purpose."[15] In an article, "Sense, Meaning

[15] "Significs and Language," Preface.

and Interpretation,'' that was published in the British journal *Mind* in 1896, in her book *What is Meaning?* (1903) and in her monograph ''Signifies and Language'' (1911) she advocated a psychological and sociological investigation of the concepts which at that time dominated in philosophic and scientific discussions. Although she made use herself of a rather vague terminology, yet there are to be found in her writings, apart from their tendency, some ideas which have strongly influenced and stimulated the activities of scientists in western Europe who in the early years of the twentieth century were impressed by the uncritical use of linguistic means in science and philosophy. The following examples taken from her above-mentioned book may be characteristic of her point of view:

> ''There is, strictly speaking, no such thing as the Sense of a word, but only the sense in which it is used — the circumstances, state of mind, reference, 'university of discourse' belonging to it. The Meaning of a word is the intent which it is desired to convey — the intention of the user. The Significance is always manifold, and intensifies its sense as well as its meaning, by expressing its importance, its appeal to us, its moment for us, its emotional force, its ideal value, its moral aspect, its universal or at least social range'' (p. 6).
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> ''It must be remembered that Signifies implies in more than one 'sense' a careful distinction between sense, meaning and significance. . . . From this point of view, the reference of sense is mainly instinctive, of meaning volitional, and of significance moral; we have a sense of discomfort, a thing is true in a certain sense, we mean (i.e. intend) to do something, and we speak of some event, 'the significance of which cannot be overrated.' '' (p. 46).

These notions of ''sense,'' ''meaning'' and ''significance'' were, somewhat liberally, interpreted by the Dutch jurist and significist *Jacob Israël de Haan* in his doctorate thesis on Juridical Significs and its Application to the notions ''liable, responsible, accountable'' (1916).

In 1896 a prize was offered by *Lady Welby* for the best treatise upon the following subject: ''The causes of the present obscurity

and confusion in psychological and philosophical terminology, and of the directions in which we may hope for efficient practical remedy." The donor of the prize desired that general regard be had to classification of the various modes in which a word or other sign may be said to possess 'meaning', and to corresponding differences of methods in the conveyance or interpretation of 'meaning.' The committee of award would consider the practical utility of the work submitted to them as of primary importance.

The prize was awarded to *F. Tönnies,* professor at Kiel, for his "Philosophische Terminologie in psychologisch-soziologischer Ansicht," in which he showed the mainly subjective character of the usual philosophical terms and advocated the foundation of an international organization for critical studies. Although *Lady Welby* died before the journal *Mind* organized a "symposium" on the "meaning of 'meaning' " about 1920, it may be said that her views have largely contributed to paving the way for this semantic and epistemologic approach to linguistic phenomena.

The Dutch psychiatrist, author, and poet *Frederik van Eeden* would become the connecting link between *Lady Welby* and the later significists in the Netherlands. At a psychological and psychiatric congress at London in 1892 he had insisted on a clarification of meaning, and this pleading for an investigation of the concepts used in psychology and other fields of science induced *Lady Welby* to get in touch with him. A series of epistemologic studies, to which belongs a remarkable essay on the "logical foundation of mutual understanding", in which the principle of gradualness was applied and a distinction was made between the volitive, emotive and indicative content of fundamental terms and concepts, was written by *Van Eeden* during the years 1893-1897. Statements like "The words of mathematics are pure symbols" and "Physical science aims at ordering and connecting our sense perceptions", occurring in the above essay, anticipate the development of the signific approach to the foundations of mathematics and physics in a relativistic and psychological direction.

The first *group* of people concerned with significs in the Netherlands met during the first World War in 1915, under the startling impression of the misleading slogans with which this war was waged and against which there seemed to exist no other remedy but general philosophical reflexion, which as a

matter of course had to be initiated in a neutral country.[16] With that object in view a committee was formed. During its deliberations differences as to the plan of action became accentuated, in the end leading to a schism. The majority founded the *International School for Philosophy* at Amersfoort; the minority thought that durable humanizing of mankind could only be attained if in the first place, besides material, also *spiritual forces and values* could be introduced into mutual understanding in an indicative and objective mode, notwithstanding their poetical and emotional origin.

This minority hoped to obtain results in the desired direction by the foundation of an *International Academy for Practical Philosophy and Sociology*. In a prospectus the following task was assigned to this Academy:

"1. To coin words of spiritual value for the languages of western nations and thus make those spiritual values enter into their mutual understanding (what could be called a 'déclaration des valeurs spirituelles de la vie humaine').

"2. To detect and combat such elements in the present system of law and in the productive activity growing under its protection, as chiefly repress or dim spiritual tendencies, and to propose appropriate limitations for the sphere of influence of law and technics.

"3. To point out and brand those words of the principal languages, which falsely suggest spiritual tendencies for ideas ultimately originating in the desire for material safety and comfort, and in so doing to purify and to correct the aims of democracy towards a universal commonwealth with exclusively administrative function."

In the prospectus this task is further explained in the following way:

"The undersigned are well aware of the fact that such a task as assigned by them to the International Academy for Practical Philosophy and Sociology has been taken up several times by philosophers individually. However, they are convinced that precisely in consequence of the individual character of the work of those philosophers their words could be efficient only for memorizing the expressed thoughts in the minds of the writer and his isolated readers, but never could find a place

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[16] See also *L. E. J. Brouwer*, "Synopsis of the Signific Movement in the Netherlands," *Synthèse*, V, Nos. 4-5.

in the mutual understanding of the multitude and therefore had only a slight social influence.

"They hold the opinion that when the same task could be undertaken in common by a group of independent thinkers with subtle and pure human feeling, their thoughts *formed in the mutual understanding of their circle*, would necessarily find a corresponding language, *allowing them to enter into the mutual understanding of the multitude.*

"Finally, as regards the realization of the proposals of the Academy, it must be kept in mind that a thought, in its quality of embryonic deed, has a far greater possibility of development when it is the common intimate conviction of a group of human beings than in the case of its belonging to one individual only, however courageous that individual may be and however numerous the company of half-understanding followers who surround him."

One of the signers was *Frederik van Eeden;* the other signers were the mathematician *L. E. J. Brouwer*, the sinologist and man of letters *Henri Borel*, and the social worker *H. P. J. Bloemers* (later on burgomaster of Groningen and Arnhem). Soon after, this group was joined by the mathematician *G. Mannoury*, the physicist *L. S. Ornstein*, and by *Jacob Israël de Haan*. The group of seven thus formed founded an *International Institute for Philosophy*, aiming at a "revision of the values of the elements of life of individual and community" and trying to attain this aim by

"*a.* establishing and supporting an International Academy for Practical Philosophy and Sociology;

"*b.* establishing and supporting a school for the propagation of the concepts and relations of concepts as introduced by the Academy;

"*c.* other means."

The primordial task of the Academy was intended to be the composing of a new vocabulary on the basis of a linguistic gradation, an item for which we may refer to the first chapter of the present monograph.

A number of thinkers were invited to take part in the activities of the Academy — among them were *Peano*, *Buber*, *Mauthner* and *Tagore* — but soon it became evident that even for the constituent assembly of the Academy financial resources failed.

The only thing left was the continuing of the personal exchange of thought of the founders, which led to the forming

of a signific circle in 1922, consisting of *Brouwer*, *Van Eeden*, the linguist *Jac. van Ginneken* (later on professor in the university of Nimeguen) and *G. Mannoury*. This *Signific Circle* proclaimed in their declaration of principles *a. o.* that signific contains more than criticism of language, also more than synthesis of language, and that in opening a deeper insight into the connections between words and the needs and tendencies of the soul, it may affect in a wholesome way the future social and mental conditions of man. But, apart from this, it emphasized the *empirical* tendencies of the signific investigation by adding that this investigation should be carried on more systematically than before and include, besides an introspective investigation into the subconscious elements, the application of experimental and statistical methods.

The *Signific Circle* for some years met regularly, and the discussions held were highly instructive to its members. *Mannoury* kept an accurate account, a small part of which was printed later on (and published in Dutch in the "Synthèse-Series" in 1939). In the meantime, in 1923, there had been issued by the same circle a circular requesting cooperation for a revision of the nomenclature in various branches of science.

After the cessation of the activities of the *Signific Circle* in 1924, the signific methodology was not practised by groups until 1937. During this period *G. Mannoury,* professor of mathematics and of philosophy of mathematics in the University of Amsterdam, also gave courses of lectures on significs, and made a special study of the signific foundations of mathematics. (Cf. his article on "Die signifischen Grundlagen der Mathematik," *Erkenntnis* IV, 1934, the French translation of which was published in the *Collection Synthèse* in 1947). *Van Dantzig*, too, gave lectures on significs in this period.

In 1937 the *International Group for the Study of Significs* was founded on the initiative of the Editorial Board of the journal *Synthèse*. Some of the editors of this journal were attached to the older significists by personal ties of friendship, and through this were familiar with the aims of this movement. Moreover, the program of this journal, aiming at giving expression to divergent systems of intellectual integration, naturally brought the group into contact with the signific views. *Mannoury* himself was one of the founders of the new and renewed circle.

Until the second World War the *International Group for the*

Study of Significs continued its activities on an international scale. It characterized its main objective as

> "The practising of analytic and synthetic significs in general, and its application to the theories of the foundations of the sociological, cultural, political and exact sciences in particular."

The working method of the group was as follows: the significs principles and the method to be applied were discussed in a "central section." In this section were also representatives of the "border-groups," including sections for biology, psychology, general epistemology, ethics and jurisprudence.

During the last year of the German occupation of the Netherlands, where the main seat of the group was located, the work of the *International Group for the Study of Significs* had to be abandoned altogether, but soon after the end of the war it was resumed, though by partly different contributors. The *International Society for Significs* was founded by representatives of both the exact and the social sciences.

The new program pursues theoretical as well as more practical aims; it continues the research into the theories of the foundations of science and aims at the building up of an efficient scientific terminology; furthermore it promotes the empirical study of group languages (content analysis, slogan analysis, bias analysis, etc.).[17]

In 1937 a regular exchange of views and publications was planned with movements characteristic of a critical attitude towards linguistic phenomena, and especially with the *Unity of Science Movement*, with whom we may also reckon the *Warsaw School* (*Lukasiewicz, Kotarbinski, Lesniewski, Tarski, Adjukiewicz, Chwistek*, and some others). In a special section of the journal *Synthèse*, called "Unity of Science Forum," conducted by *Philipp Frank, Charles W. Morris* and *Otto Neurath*, leading logical empiricists have explained their views on a renewed criticism of language. Since 1948, *Philipp Frank* and *Charles Morris* have been the editors of a section in *Synthèse* under the heading "Logical Empiricism", in which a series of papers have been and will be published which treat Logical Empiricism as a phenomenon in the intellectual history of the 20th century.

For some years papers on sociological subjects have been pre-

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[17] Part of the activities of the *International Society for Significs* have been described in chapter III of this monograph.

pared for publication in *Synthèse* by the *Institute Français de Sociologie* at Paris, counting among their members sociologists who are taking an active part in the activities of the Significs Society.

In the Spring 1948 issue of *ETC., a review of General Semantics,* the editors announced the institution of regular correspondence with the *International Society for Significs,* and expressed the hope that this exchange will lead to cooperative editorial and research activities between the *International Society for General Semantics* and the *International Society for Significs.* In the course of these five years fruitful discussions on sign problems have resulted from this cooperation.

Every year the *International Society for Significs* organizes an international conference dealing with problems on criticism of language and the relation between language and behavior. The *Eighth International Significs Summer Conference* was held in September 1952 and was devoted to the study of "Non-scientific elements in the development of science." The proceedings of these conferences and also some of the reports of the sections of the Society are printed in *Synthèse.*

Glossary

This glossary includes only some of the main terms used in the text of the present monograph. It aims to facilitate the reading of this text by giving a definition of those terms which are or might be used in a somewhat other acceptation in other theories of signs. Most of the terms are also defined in the text. The monograph being written in conversational language, the concepts employed are by far not defined in significs terms. In the definitions given below vernacular terms operate as primitive terms.

Act of communication In a wider sense: an act by which one individual or a group of individuals (the "speaker") aims at influencing the behavior of another individual or group of individuals (the "hearer"); in a narrower sense: the linguistic behavior characterized by the use of word-language, either spoken or written or denoted by signals.

Analytic significs See *Significs.*

Concept Psychic correlate of a class of words having a similar function or tendency.

Dispersion Variability of the signification of an act of communication with regard to different individuals or to one individual under emotive or environmental influences. (Intersubjective and intrasubjective dispersion.)

Functional elements Elements of the active and passive signification, to be distinguished in *indicative, emotive* and *volitive* elements, according as they bear upon the representations, the "distribution of affection" and the intention of speaker and hearer.

Hearer See *Act of communication.*

Language In a wider sense: the procedures by which one mind may affect another; in a narrower sense: the vocal and auditive means of communication.

Psychic correlate Mental associations connected with a word-picture or a group of word-pictures.

Signification In a wider sense (the signification of an act of communication): the influence aimed at by the speaker and which the hearer undergoes (active and passive signification), and also the environmental influences affecting the act of communication (symptomatic signification); in a narrower sense (signification of a word): the function of a word or an expression in the act of communication in which this word or this expression is used.

Significs Systematic study of the mental and linguistic phenomena of communication, to be distinguished in *Analytic significs,* being the psychological investigation of the existing means of communication, and *Synthetic significs,* aiming at extending and improving the means of communication in use.

Speaker See *Act of communication.*

Synthetic significs See *Significs.*

Word-image
Word-picture The mental associations connected with the hearing, the reading, the pronouncing or the writing down of a word (auditive, visual, and motorial word-picture).

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